

BIOTIC COMMUNITIES OF THE NORTHERN
DESERT SHRUB BIOME IN
WESTERN UTAH

BY

REED WINGET FAUTIN

B.S., Brigham Young University, 1936

M.A., University of Illinois, 1938

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
ZOOLOGY IN THE GRADUATE SCHOOL OF THE
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ACKNOWLEDGMENTS

The author wishes to express his sincere appreciation to Professor V. E. Shelford, under whom this work was done, for his suggestions, encouragement and help which have been invaluable. His assistance included a trip to Utah during the summer of 1938 where he visited the study area with the author and outlined the problem to be undertaken.

Appreciation is also expressed to the Society of Sigma Xi for awarding the author a Grant-in-aid which was used in the completion of this research during the summer of 1940.

Without the assistance of the many specialists who helped in the determination of the plants and animals collected, the identification of the numerous biotic components included in this study would have been impossible. The cooperation of these individuals is greatly appreciated and thanks are extended to the following: B. F. Harrison, Brigham Young University; Nathan Banks, Museum of Comparative Zoology at Harvard College; C. R. W. Muesebeck, H. E. Ewing, G. Glance, J. C. Crawford, H. G. Barber, P. W. Oman, P. W. Mason, Harold Morrison, E. A. Chapin, H. S. Barber, R. E. Blackwelder, W. S. Fisher, L. L. Buckman, W. H. Anderson, Carl Heinrich, C. T. Greene, Alan Stone, David G. Hall, A. B. Gahan, R. A. Cushman, and M. R. Smith of the U. S. Bureau of Entomology; Ralph V. Chamberlin and S. D. Durrant, University of Utah; R. A. Cooley, U. S. Public Health Service; H. B. Mills, Montana State College; John W. H. Rehn and W. T. M. Forbes, Cornell University; Herbert Ruckes, College of the City of New York; H. H. Knight and H. M. Harris, Iowa State College; Wm. T. Davis, Staten Island Museum; George F. Knowlton, Utah State Agricultural College; Robert Traub, University of Illinois; Clarence E. Mickel, University of Minnesota; E. Raymond Hall, University of California

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Although the plant communities of western Utah have received considerable attention because of their economic importance and significance as indicators of soil conditions in relation to agriculture, and considerable is known about the animals of that area, no attempt has been made to interpret their bio-ecological community relationships. This investigation was undertaken for that purpose and an attempt is made to define the biotic communities of the areas studied and their relationships to the major biotic units (biomes) of the Great Basin region below the pinon-juniper woodland.

AREAS STUDIED AND METHODS EMPLOYED

The investigation of the shadscale association and its associated communities was conducted in the western part of Millard County, Utah. The focal point of the investigation was White Valley which is located 65 miles west of Delta, Utah and is bisected by the 113th meridian and extends in a north and south direction from the 39th parallel to the 39° 35'. The sagebrush community studied is located in Fernow Valley about 20 miles west of Nephi, Utah in the eastern part of Juab County.

Field observations were made during a part of two years, from June to September 11, 1939 and from April to September 6, 1940. Quantitative methods were employed in studying both the plant and animal components of the communities concerned, supplemented by general field observations. The determination of the plant constituents was accomplished by plotting the position of each plant within 0.25 square rod quadrat samples. From these samples the plant components for each community were calculated in terms of per cent of total plant composition, frequency of occurrence, and per cent of total area covered. Quantitative samples of the inverte-

brates from the various dominant shrubs were obtained by taking fifty sweeps with an insect net 30 centimeters in diameter. Such samples were taken every one or two weeks.

The frequency with which the larger mammals were seen and heard, together with the frequency with which their 'signs', in the form of scat, tracks and dens, were encountered, were used as indices of their relative abundance. Bird and rabbit populations were determined by counting the number seen in 4-hectare (10-acre) sample plots, supplemented by the pellet count method. Small rodent populations were determined by trapping 0.4-hectare (1-acre) and 0.2-hectare (0.5-acre) plots for four consecutive nights. Sixty such plots were trapped during the course of the investigation. Reptile populations were determined by counting the number seen on the plots utilized for trapping rodents.

Food relations were investigated by examining the contents of stomachs and pellets; by observing feeding activities in the field; and by noting food preferences of captive animals. The time of reproduction was determined by examining the reproductive organs of collected animals; observing mating and nesting activities in the field; and by observing the time of the appearance of the young in the field.

Daily records were kept of the temperature, relative humidity, and rate of evaporation. These data were supplemented by climatic data from nine different government weather stations located in widely distributed localities throughout western Utah.

SUMMARY AND CONCLUSIONS

1. The Great Basin region at elevations below the pinon-juniper woodland and extending from the Palouse prairie in southeastern Oregon and northern Utah to about the thirty-seventh parallel in southern Nevada, where it merges into the Southern Desert Scrub Biome, is designated as the Northern Desert Shrub Biome. This biome is climatically and biotically different from the southern desert biome and is characterized by a variety of widely-spaced dominant deciduous shrubs, ac-

accompanied by several dominant grasses and subdominant undershrubs and herbs.

2. The Northern Desert Shrub Biome is divisible into two associations on the basis of climatic and biotic differences. These are designated as the Sagebrush Association and the Shadscale Association. Temperature conditions are similar in both associations but the amount of precipitation is almost 100 per cent greater in the sagebrush areas than in the shadscale areas. In response to this difference in the amount of precipitation the sagebrush communities are found along the windward bases of the mountains and at the higher elevations where the soil is deep, more permeable, and relatively saline-free for at least to a depth of about three feet. The shadscale communities are more extensive and occupy the more xeric areas where the soil is often heavily impregnated with mineral salts.

3. Considerable variation occurs within the shadscale association with the result that a number of distinct biotic communities (faciations) are differentiated through the deletion or addition of one or more dominants. These variations are the result of differences in the amount and availability of soil moisture which is altered by the texture and mineral content of the soil. The communities investigated include the shadscale association and the greasewood, tetradymia, winter-fat, and Black Knolls faciations, each of which is characterized by rather sharp boundaries and one or two dominant shrubs and grasses, accompanied by a very limited number of subdominant undershrubs and herbs. The major permeant influents are much the same in all the communities and are found throughout the biome. The minor and subinfluents are more abundant and distinct for each community but in some cases the differences are largely quantitative rather than qualitative.

4. The greasewood community occupies the lower parts of the valley where the salt content of the soil is high but where the water table is near enough to the surface to provide an adequate supply of moisture for the dominant plants. As this community extends towards the outer edges of the valley floor

shadscale becomes increasingly more abundant and a wide ecotone is formed between these two communities.

The shadscale community extends from the border of the valley floor toward the base of the mountains and occupies a greater part of White Valley than any other community. As this community approaches the bases of the mountains a new dominant, tetradymia, comes in. The tetradymia community thus occurs as a rather narrow band near the base of the mountains where the soil is coarse and well drained and consequently where the most xeric conditions prevail.

In certain areas where the soil is sandy but well drained and usually where the drainage waters from the higher areas spread out over the surface, winter-fat becomes the most abundant plant but it is usually accompanied by some shadscale and Indian ricegrass. This community is very restricted in its distribution and has probably been greatly reduced in extent by heavy grazing practices.

The Black Knolls community occupies a series of black lava rock knolls in White Valley and is more closely related to the tetradymia community than to any other, but due to the rocky and broken terrain, other dominants are present and several of the influent animals are unique.

5. The major influent animals which range throughout these communities include: the coyote, antelope, badger, burrowing owl, desert fox, and Swainson's hawk.

6. Kangaroo rats are the most prevalent minor influents. Two species, *Dipodomys microps bonnevilliei* Goldman and *Dipodomys ordii celeripes* Durrant and Hall, occur in the communities studied but the abundance of each varies from one community to another. In the shadscale association they constituted 88 percent of the total rodent population while in the greasewood community they made up only 40 per cent of the total. *Dipodomys microps* occurs in all the communities and varied in abundance from 4.37 per hectare in the sagebrush community to 21 per hectare in the shadscale community. *Dipodomys ordii* is restricted to those communities where the soil is relatively fine in texture and varied in abundance from

6.18 in the greasewood community to 0 in the Black Knolls community.

Shadscale leaves constitute the major source of food for both species although the leaves and seeds of various other dominant shrubs and grasses are also utilized to a more limited extent. Reproduction occurs during the early spring months, the time of reproduction tending to be about a month earlier in *Dipodomys microps* than in *Dipodomys ordii*.

7. Other important rodents present include the white-footed mouse, *Peromyscus maniculatus sonoriensis* (Le Conte), which occurs in all the communities except the Black Knolls community where it is replaced by an ecological equivalent, *Peromyscus crinitus pergracilis* Goldman. The grasshopper mouse, *Onychomys leucogaster brevicaudus* Merriam, occurs in the shadscale, winter-fat, tetradymia and greasewood communities although it was never abundant. The harvest mouse, *Reithrodontomys m. megalotis* (Baird), occurs only in the greasewood and sagebrush communities where the vegetation is most dense. The kangaroo mouse, *Microdipodops pallidus albiventer* Hall and Durrant, occurs only in the winter-fat community and in areas where the soil is sandy. The little pocket mouse, *Perognathus longimembris nevadensis* Merriam, occurs in all the communities except the Black Knolls where it is replaced by *Perognathus f. formosus* Merriam, and in the sagebrush community where its place is taken by *Perognathus parvus olivaceus* (Merriam). The desert pack rat, *Neotoma l. lepida* Thomas, is found only in the tetradymia and Black Knolls communities where large rocks and cliffs provide adequate places for its dens. The pocket gopher, *Thomomys bottae centralis* Hall, occurs throughout most communities except where the soil is very rocky. The antelope ground squirrel, *Citellus l. leucurus* (Merriam), is most abundant in the shadscale community, while the Piute ground squirrel, *Citellus townsendi mollis* (Kennicott), is more abundant in the more moist situations where grass is present. The sagebrush chipmunk, *Eutamias minimus* ssp., is restricted to the sagebrush community.

8. The black-tailed jack rabbit, *Lepus californicus deserticola* Mearns, ranges throughout all the communities but is most abundant in the greasewood and sagebrush communities where it varied in abundance from .5 to 2.2 rabbits per hectare with an average of 1.07 per hectare in the sagebrush community and 1.25 in the greasewood community.

Cottontails, *Sylvilagus nuttallii grangeri* (Allen), occur regularly only in the tetradymia and Black Knolls where large rocks, ravines, and ledges are present. They are never numerous and averaged only 2.8 individuals per 10 hectares.

9. Passerine bird populations are low and the number of species is small. Populations are highest in April and May in the shadscale and tetradymia communities where they amount to slightly over 2 birds per hectare but they decline to about 1 bird per hectare during the following summer months. Populations in the greasewood community increased from 2.5 per hectare in the spring to 5.5 in the autumn as birds from adjacent communities moved into this community where a greater amount of cover and insect food is available. Breeding species in the greasewood and sagebrush communities are very similar and include the sage sparrow, Brewer's sparrow, sage thrasher, and the Nevada shrike. The only bird which breeds regularly in the shadscale and winter-fat communities is the desert horned lark. The black-throated desert sparrow and the rock wren are the only breeding species in the tetradymia and Black Knolls communities.

10. Reptiles are very important minor influents from April to August but their ecological importance is reduced by their short period of activity. This group includes six species of lizards and four species of snakes. The gopher-snake, *Pituophis catenifer deserticola* Stejneger, and the rattlesnake, *Crotalus viridis lutosus* Klauber, are the two most abundant species and were most frequently encountered in the shadscale community.

The brown-shouldered uta, *Uta s. stanburiana* (Baird and Girard), is the most abundant lizard and is the first one to come out of hibernation in the spring. It is most abundant

during April and May at which time it reached a maximum abundance of 20 per hectare in the tetradymia community. The whip-tailed lizard, *Cnemidophorus t. tessellatus* (Say), attained its greatest abundance of 8 per hectare in the shadscale and tetradymia communities during the last part of May. The leopard lizard, *Crotophytus wislizenii* Baird and Girard, occurs in all communities except the Black Knolls community where it is replaced by the collared lizard, *Crotophytus collaris baileyi* Stejneger, which is in turn restricted to those communities where large rocks are present. The horned-toad, *Phrynosoma platyrhinos* Girard, is one of the most widespread species of lizards but is less abundant than most other species. The sagebrush swift, *Sceloporus g. graciosus* (Baird and Girard), occurs only in the sagebrush and greasewood communities.

11. The brown-shouldered utas begin laying eggs about April 15th and have about completed their egg-laying activities by the last of May when the other lizards are just beginning to deposit their eggs. In all other species egg-laying continues until about the first part of July. The young lizards begin to make their appearance during the last part of July and the first part of August at which time most of the adults have gone into aestivation.

12. The food of lizards consists primarily of insects, the kinds of insects eaten being those which are the most abundant. Terrestrial insects such as ants and ground beetles constitute the greater part of the diet of the strictly terrestrial lizards such as the uta and horned toad, while the shrub-inhabiting hemiptera and homoptera are most frequently eaten by the shrub-inhabiting sagebrush swift. The leopard lizard and collared lizard are carnivorous and feed to a considerable extent on utas.

13. Among the most conspicuous and important groups of invertebrates are the ants, tenebrionid beetles and spiders. Invertebrate populations and composition vary greatly from one community to another, their abundance being greatest in the sagebrush community and lowest in the shadscale community. Arachnids, orthoptera, lepidoptera, diptera and hymenoptera

were most abundant in the greasewood community; homoptera and coleoptera in the sagebrush community; and thysanoptera and hemiptera in the tetradymia community. In all communities except the greasewood community the invertebrate populations reached their highest point during May and then rapidly declined as the summer temperatures rose and the precipitation decreased, with the most rapid decline occurring in the tetradymia community. Populations in the greasewood community remained fairly constant throughout the summer reaching a maximum about the middle of June when the invertebrate populations of other communities were beginning to decline.

14. Observations on the activity of kangaroo rats and honey ants indicate that the time at which these species are active is dependent to a large extent on the daily mean temperature, their time of activity being progressively delayed until later hours of the night as the daily summer temperatures rise.

VITA

Reed Winget Fautin was born January 2, 1908 at Monroe, Sevier County, Utah. He was graduated from the South Sevier High School at Monroe, Utah in 1927. In the autumn of 1929 he matriculated at the Brigham Young University, Provo, Utah. From 1930 to 1932 he was engaged in industry at the end of which time he resumed his studies at the Brigham Young University where he received the degree of Bachelor of Science and was graduated with honors in 1936. He began his graduate work at the Brigham Young University in the Department of Zoology in the autumn of 1936. From 1937 to 1941 he was a graduate student at the University of Illinois where he was granted the degree of Master of Arts in Zoology in 1938.

From 1935 to 1937 he served as an assistant in the Department of Zoology at the Brigham Young University and from 1937 to 1941 as an assistant in the Department of Zoology at the University of Illinois. He did graduate work at the Hopkins Biological Marine Station, Pacific Grove, California, during the summer of 1938 and during the summers of 1939 and 1940 he was engaged in an investigation of the biotic communities of the desert region of western Utah, for the completion of which investigation he was awarded a Sigma Xi Grant-in-aid during the summer of 1940.

He is an active member of the Illinois Chapter of Sigma Xi, (1940) and the Rho Chapter of Phi Sigma, (1938)

